Keywords: *Space Acquisition, Space Industrial Base, Export Licensing, System Dynamics Modeling, International Traffic and Arms Regulations (ITAR)*

U.S. Space Acquisition:

Challenges in the Final Frontier

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Space contributes to the security and economic stability of the United States. However, numerous studies, articles, and surveys state export control is hurting the space industrial base. The nation's ability to acquire space systems, according to many published sources, is diminishing and may impact its leadership in the field of space. Many claim excessive export controls as one of the primary causes and often cite statistics, data, and information contained within a 2007 Air Force Research Laboratory (AFRL) survey to validate their claim. While the AFRL survey certainly provides insight and should not be entirely discounted, the application of System Dynamics Modeling suggests the survey's findings on export control are outdated.

image designed by Diane Fleischer »

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
JAN 2012		**00-00-2012 to 00-00-2012**

4. TITLE AND SUBTITLE
U.S. Space Acquisition: Challenges in the Final Frontier

5a. CONTRACT NUMBER
5b. GRANT NUMBER
5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

5d. PROJECT NUMBER
5e. TASK NUMBER
5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Defense Acquisition University Press,9820 Belvoir Rd, Suite 3,Fort Belvoir,VA,22060

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR’S ACRONYM(S)

11. SPONSOR/MONITOR’S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
See also ADA560045, ARJ, January 2012, Vol. 19 No. 1 : 075 - 098

14. ABSTRACT
Space contributes to the security and economic stability of the United States. However, numerous studies,articles, and surveys state export control is hurting the space industrial base. The nation?s ability to acquire space systems, according to many published sources,is diminishing and may impact its leadership in the field of space. Many claim excessive export controls as one of the primary causes and often cite statistics, data, and information contained within a 2007 Air Force Research Laboratory (AFRL) survey to validate their claim. While the AFRL survey certainly provides insight and should not be entirely discounted, the application of System Dynamics Modeling suggests the survey?s findings on export control are outdated.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**25**	

"In this new century, those who effectively utilize space will enjoy added prosperity and security and will hold a substantial advantage over those who do not.... In order to increase knowledge, discovery, economic prosperity, and to enhance the national security, the United States must have robust, effective, and efficient space capability."

—Executive Office of the President, 2006

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The Cold War amplified space as a national interest and helped secure the nation's position as a world leader in the field. Evolving space capabilities through and beyond the Cold War have enabled the United States to increase the sophistication of its technology and significantly improve the quality of life for its citizens. The development of space capabilities has allowed the nation to explore the moon, probe planets, and send spacecraft beyond our solar system and into the Milky Way Galaxy. Additionally, space systems have substantially contributed to our understanding of our own planet as well. The proliferation of space systems and space technology has acted as a catalyst in developing new markets and creating new economic opportunities. It has furthered medical research such as advances in studying the effects of bone loss and even resulted in the development of drugs to treat various forms of cancer. It has also changed the way in which we communicate and the manner in which we enjoy entertainment media and services such as satellite Internet, television, and radio.

Space has also significantly contributed to our national security. Space-based assets provide information for our military forces in denied areas. Such assets enable the monitoring of political and military developments of our adversaries and reduce the risk of surprise. Space systems have also changed the means by which we conduct war. From the early moments of the first Persian Gulf War, satellites demonstrated they were a force multiplier on the strategic, operational, and tactical level. For the first time, satellites connected geographically separated military forces with national-level decision makers in near real time, and enabled the collection of data on operationally relevant conditions in surveying and targeting hostile forces (Hamel, 2006). Not surprisingly, our military forces continue to rely upon space-based assets for

operations throughout the world. In short, "our national security and public safety, global economic competitiveness, and scientific capabilities are all reliant on access to space and space-based capabilities" (Pace, 2009).

However, a number of issues are challenging our ability to acquire space systems, which may adversely impact our national security. Among those issues is concern for the space industrial base. In short, various surveys, articles, government reporting, and white papers suggest the health of the nation's space industrial base may be in decline. In particular, the Air Force Research Laboratory (AFRL) survey of the industrial base revealed relatively flat profits, smaller research and development programs, a shortage of skilled workers, and shrinking defense budgets as evidence of an unhealthy space industrial base (Department of the Air Force, 2007).

Discounting national security, there appears to be almost unanimous agreement across the field of experts that U.S. export control regulations are hurting the industry economically. Aside from being overly complex, experts are expressing particular concern with wait times for export licenses, and attributing long processing times to a loss of sales in the international market. In fact, according to the Satellite Industry Association (SIA), estimates reflect that from 1999–2005, the

U.S. satellite industry lost anywhere between $2.5 billion to $6 billion in revenue (Krause, 2008). Given a weak business case and marginal revenue, many space firms are leaving the industry for more lucrative markets. Should the trend of firms leaving the market continue, the Department of Defense (DoD) could find itself relying upon foreign providers for the specialized parts needed in the development of its space programs.

Noting the focus on the space industrial base and the export control process, the authors of this article seek to accomplish four objectives.

- First, briefly review the state of the space industrial base as described by the AFRL survey.
- Second, provide a brief overview of the current export control process.
- Third, using the System Dynamics Model, review the current export control license process and evaluate its results against those of the AFRL survey. Further, determine whether the views of the AFRL survey on licensing still apply in today's world of exports.
- Fourth, provide a set of recommendations aside from export control reform that may increase the competitiveness of the industry.

State of the Space Industrial Base

A survey of the space industrial base was conducted in 2007 by the Department of Commerce Bureau of Industry Security (BIS), AFRL, the National Security Space Office, and the Federal Aviation Administration Office of Commercial Space Transportation. A more current survey is in progress, and its results are expected in the 2012–2013 timeframe. The AFRL survey was implemented in three phases and was designed to evaluate the impact of export control regulations on the health of the industry. The survey was administered to 274 space firms with 74 percent or 202 firms actually responding to the survey (Department of the Air Force, 2007). Although the survey was much more encompassing, for our purposes we will examine its observations on licensing processing times and its effects on sales and market share.

Export License Processing

The survey collected data associated with export licensing between the years 2002–2006 and explored two themes. The first included reviewing the number of licenses applied for and categorizing them into approved and disapproved. The second theme involved the actual time it took to apply for a license and receive notice on its determination.

According to the survey, the number of export license applications received has consistently increased from 2002–2006. On average, space industrial firms submitted over 1,100 applications a year during this time period, and less than 1 percent of those were rejected (Department of the Air Force, 2007). Although less than 1 percent of all applications were rejected, the general trend in processing time between the years 2002–2006 increased. Average processing time in 2002 was just 52 days, and by 2006 had more than doubled to 106 days (Department of the Air Force, 2007). This would effectively prohibit a firm from competing in international bids as it would most likely fail to respond within established timelines. Since then, the Department of Commerce and the Department of State have implemented an electronic application system as well as increased staffing and training, resulting in significantly decreased license processing times.

Sales and Market Share

The survey calculated that the U.S. space industry lost over $2.35 billion between the years 2003–2006 (Department of the Air Force, 2007) In terms of percentages, 2003 was the hardest year, where the industry lost 45.2 percent of its overseas sales (Department of the Air Force, 2007). Between 2004 and 2006, the percentage of U.S. shares in the international market steadily declined. Within satellite manufacturing alone, U.S. firms held 63 percent of the satellite manufacturing market in 1998, whereas in 2006 they only possessed 42 percent of the market (Department of the Air Force, 2007). Correspondingly, revenues for satellite manufacturing dropped from $6.6 billion in 1998 to $4.2 billion in 2006 (Department of the Air Force, 2007). Further, many firms reported they believed export control presented an opportunity for foreign competitors to capture a greater share of the market. In fact, Europe increased its market share of launch services from 9 percent in 1998 to 23 percent in 2006 (Department of the Air Force, 2007). Consequently, approximately 25 percent of firms responding to the survey indicated they would now focus their efforts on the domestic market (Department of the Air Force, 2007).

Further, declining sales during this time period corresponded with a decline in revenue as a significant portion of firms reported profit margins of only 4 to 6 percent (Department of the Air Force, 2007). These low profit margins mean less revenue for firms to invest in their personnel, and in their research and development. Combined with pressures from prime contractors to provide the "best possible price," these firms then become less competitive—thus, we see a "hollowing out of the supply chain" (DeFrank, 2006). Additionally, the Suppliers Excellence Alliance asserts that 50 percent of all second- and third-tier suppliers will cease to exist within the next few years (DeFrank, 2006). This represents a serious problem as the primary contractors (Lockheed Martin, Boeing, Northrop Grumman, etc.) subcontract out approximately 80 percent of their space acquisitions to these lower tiered firms (DeFrank, 2006).

However, in light of new and more current data, this survey's view on the industry may no longer portray a true picture. (This will be addressed later in the article.) Nonetheless, this survey, along with numerous other studies, white papers, and articles, served to focus the spotlight on export control reform for the federal government—specifically, the drive for a single export control list, a single export licensing agency, a single information technology system, and a single export enforcement agency. In the next section, we examine export control regulations in more detail.

Export Control Regulations

The purpose of export control is to prevent sensitive technologies from falling into the hands of adversaries who stand to gain an advantage. Although created from a number of congressional acts dating back as early as the 20th century, the *Arms Export Control Act (AECA) of 1976* and the *Export Administration Act of 1979* are perhaps the most significant. This legislation empowers the President of the United States with responsibility for the control of imports and exports of defense-related items, services, and articles, etc. (AECA, 1976). Additionally, it also authorizes the President to issue policy guidance to those entities involved in the import and export of defense items.

Today, the Department of Commerce and the Department of State are primarily responsible for implementing export control. The Department of Commerce administers the Commercial Control List (CCL) and primarily examines items for export that have a "dual-use" application. The Department of State administers the International Traffic and Arms

Regulations (ITAR) through the United States Munitions List (USML) under the auspices of the Arms Export Control Act of 1976. Through the USML, the Department of State primarily seeks to prevent sensitive technology, services, articles, and information from falling into the hands of a possible adversary.

However, a number of other agencies and organizations play smaller or secondary roles. Some of these include the DoD, which administers for the Department of State its Foreign Military Sales through DoD's Defense Security Cooperation Agency; the Department of Energy, which monitors exports for compliance with nuclear nonproliferation; and the Department of Treasury in ensuring trade does not occur with embargoed nations. Still other agencies include the U.S. Customs Agency, the Office of Foreign Asset Control, the U.S. Census Bureau as well as the Office of Management and Budget. The list of players continues to expand when it comes to enforcement of export control, i.e., conducting investigations and prosecutions when violations occur. These include the Department of Homeland Security through the Customs and Border Protection as well as the Department of Justice through the Federal Bureau of Investigation.

The result is a myriad of organizations with overlapping responsibilities, employing various means and methods for tracking and reporting, administering differing levels of training, and even using different export control lists. Nonetheless, U.S. space firms are expected to navigate through this maze of bureaucracy and comply with regulations. Failure to do so is severe, often resulting in significant financial penalties and jail time. Indeed, barring a firm from participating in exports is the probable outcome for any firm failing to comply with regulations. For example, in one case an individual was charged two fines of $250,000 and was sentenced to 5 years in prison for exporting without a license (Cheadle, 2005).

ITAR

Managed by the Department of State under the Office of the Directorate of Defense Trade Controls (DDTC), ITAR uses the USML to determine if an article or service is deemed defense-related through the following criteria (Department of State, 2011a):

- An item that is specifically designed, developed, or modified to meet a military purpose.
- An item that largely does not have a civil application or role.
- An item that does not have a civil equivalent in terms of performance.
- An item that has significant military or intelligence applicability.

ITAR defines an article or service as "any item or technical data ... recorded or stored in any physical form, model, mockups, or other items that reveal technical data ... it does not include basic marketing information on function or purpose or general system descriptions" (Department of State, 2011a). It further defines major defense equipment as "any item of significant military equipment on the U.S. Munitions List having a nonrecurring research and development cost of more than $50,000,000 or a total production cost of more than $200,000,000" (Department of State, 2011a). Unfortunately for the U.S. space industrial base, a satellite has been classified as a munition in its entirety, including literally the nuts and bolts that are used to hold it together. This is a result of the Strom Thurmond National Defense Authorization Act of 1999, which states, "Due to the military sensitivity of the technologies involved, it is in the national security interests of the United States that United States' satellites and related items be subject to the same export controls that apply under United States law and practices to munitions" (National Defense Authorization Act, 1999). Space systems and related items can be found in category IV: Launch Vehicles, Guided Missiles, Ballistic Missiles, Rockets, Torpedoes, Bombs, and Mines as well as category XV: Spacecraft Systems and Associated Equipment (Department of State, 2011a).

A firm can request clarification if its item falls under ITAR or challenge the presence of an item on the USML by implementing a Commodity Jurisdiction Request. Under this procedure, an entity may submit

a letter to the Department of State as well as materials for examination to determine under which jurisdiction an item falls. Upon receipt of the request, the Department of State will examine the materials using a cross-functional set of agencies to determine jurisdiction (Cheadle, 2005). Although firms may continue to conduct business, they must treat these items as under the USML until a final determination is made.

Export Administration Regulations

The Export Administration Regulations (EAR) are overseen by the Department of Commerce and derive their authority from the Export Administration Act of 1979. EAR pays close attention to those items labeled as dual use. This term is used to identify an article that may have both a military/strategic application as well as a commercial application. Its use also distinguishes an item that has purely a military/strategic application from a dual-use item. Nonetheless, EAR also covers some items that have solely civil uses.

Under the EAR, the Department of Commerce defines an export as an item leaving the United States for a foreign destination. An item can be physical in nature such as clothing, electronics, mechanical equipment, etc., but it can also be virtual in nature such as an e-mail with schematics for a vehicle. Regardless, it doesn't matter how the item arrives at a foreign destination; as long as it leaves the United States for a foreign destination, it is considered an export.

The Department of Commerce, through the BIS, monitors and controls the export of commercial items. According to the BIS, very few commercial items need an export license. However, exporters are responsible for determining if they need an export license for their item. Most item designations can be found by referencing the CCL through an Export Control Classification Number. The CCL is organized around 10 broad categories that are further defined by five product groups. For our purposes, we are expressly interested in Category 9: "Propulsion Systems, Space Vehicles, and Related Equipment" (Department of Commerce, 2007b; 2008; 2009; 2010).

The Export Control Model

The Export Control Model was built using System Dynamics Modeling software that allows the user to "link" relationships between objects. Once relationships are defined, a series of rates and flows are established enabling the user to examine the behavior of the system. In our particular case, we are interested in the number of export license applications that are received, how fast they are processed, and how many are approved.

This particular model is comprised of two modules representing the Department of Commerce and the Department of State. Each module is further defined by two submodules. The Department of Commerce model contains a Submitted Export License Applications submodule, but unlike the State Department's Commodity Jurisdiction Request submodule, the Department of Commerce model contains a Commodity Classification Requests submodule (Figure 1). The Department of State module is comprised of a Commodity Jurisdiction Requests submodule and a Submitted Export License Applications submodule.

FIGURE 1. EXPORT MODEL MODULE OVERVIEW

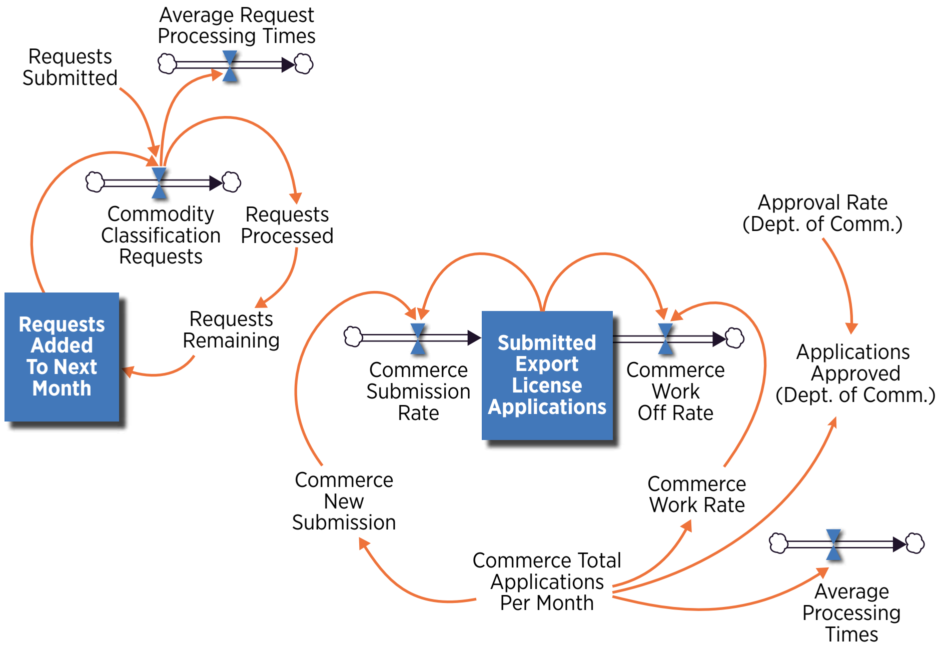
Department of Commerce	
Commodity Classification Requests	Submitted Export License Applications

Department of State	
Commodity Jurisdiction Requests	Submitted Export License Applications

Department of Commerce Model

As previously mentioned, the Department of Commerce Model is comprised of two submodules (Figure 2). Data for this model were collected from BIS Annual Reports between 2007 and 2010. The model works on a monthly cycle and carries out to 100 months. Thus, the model runs projections roughly over 8 years and allows us to view any anomalies with perspective should they occur.

FIGURE 2. DEPARTMENT OF COMMERCE MODEL



Commodity Classification Requests submodule. Commodity Classification Requests are submitted anytime a potential exporter is unsure of how to classify an item identified for export; the "Request Submitted" input represents this function. A random uniform function embedded in the "Commodity Classification Request" input generates a number of requests each month, which are received by BIS based upon data found in the BIS annual reports. The lowest number of requests submitted by year was 5,878, whereas the highest number of requests submitted by year was 7,360 (Department of Commerce, 2007a; 2008; 2009; 2010). The yearly totals are divided by 12 (490 and 613 respectively) as the model runs on a monthly cycle. The results are fed into the "Average Request Processing Times" calculator to determine the average time required to process a request. Results are then fed into"Requests Processed" to run the simulation for aerospace requests only. Taken together, we see the model produced on average 24 to 30 applications a month that were processed within 33 to 42 days. Those requests not completed within the month are stored in "Requests Remaining" and are then fed into "Requests Added to Next Month."

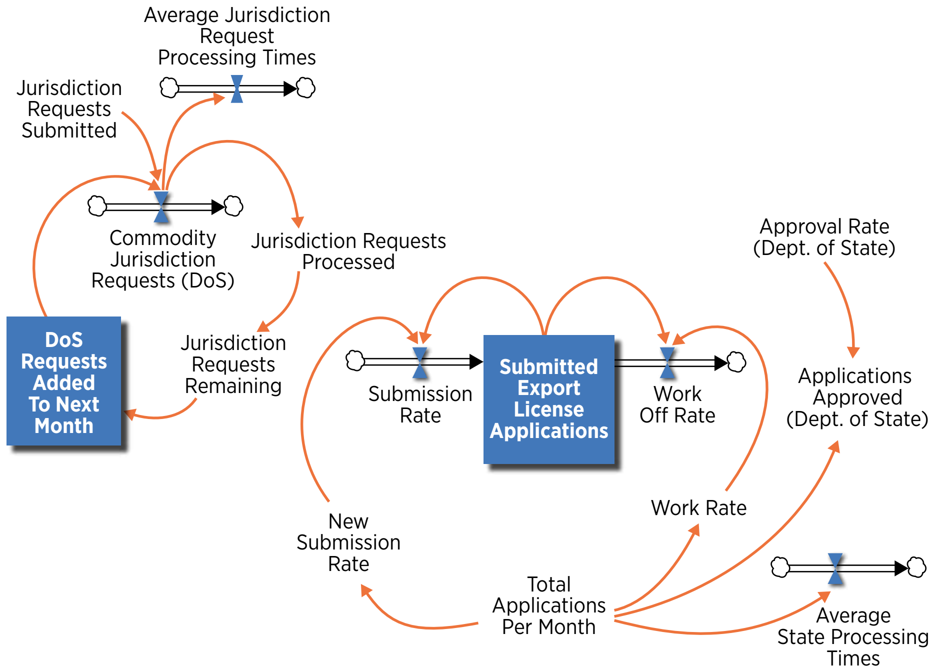
Submitted Export License Applications submodule. Data for the Submitted Export License Applications submodule were again collected from BIS annual reports between the years 2006 through 2010. Data were provided over the entire year and represent all exports that fall under the CCL, not just Category 9: Aerospace and Propulsion. However, Appendix E of the Bureau of Industrial Security Annual Report: Approved Applications for Country Group D, provides a breakout of the number of licenses by category type. The model begins with "Commerce Total Applications Per Month," which is embedded with a random number generator to simulate the total number of export license submissions. This number is then circulated through submission flows and work-rate flows to simulate the actual number of aerospace applications arriving and how fast they are worked off. It also feeds the "Average Processing Times" and "Approval Rate" to simulate typical processing times and approvals of submitted license applications. Thus, reviewing years 2006 through 2010 revealed that the average number of Aerospace and Propulsion licenses hovered around 5 percent. The model simulates this data by dividing the yearly data by 12 and then multiplying that result by 5 percent. On average, the lowest amount of applications submitted was 1,537 per month, and the highest amount was 1,754 applications per month (Department of Commerce, 2006; 2007a; 2008; 2009; 2010). Running the simulation with factoring just for the Aerospace and Propulsion category, the model produces about 77 to 88 export licenses per month.

According to BIS, approximately 84 percent of all applications are approved, and approximately 15 percent are returned without action (Department of Commerce, 2006; 2007a; 2008; 2009; 2010). Applications returned without action are usually the result of incomplete applications, missing information, and/or conflicting data. Thus, only about 1 percent of all applications are rejected. Additionally, the model simulates processing times described in the BIS Annual Report as averaging between 26 and 29 days.

Department of State Model

The Department of State baseline model (Figure 3) also contains two submodules—a Commodity Jurisdiction Requests submodule and a License Applications submodule. Data for the License Applications submodule were obtained from various sources including BIS Annual Reports and Department of State Section 655 Reports between the years

FIGURE 3. DEPARTMENT OF STATE (DoS) BASELINE MODEL



2006 and 2010 as well as metrics reported on the Department of State website. Like the Department of Commerce model, this model also simulates 100 months of activity.

Commodity Jurisdiction Requests submodule. The Commodity Jurisdiction Requests submodule works in the same manner as the Commodity Classification Requests submodule and attempts to simulate the number of jurisdiction requests the DDTC would typically receive on a monthly basis and, on average, how long it takes to process those requests. The purpose of this submodule is to determine if there are excessive delays preventing a firm from responding to a Request for Proposal in a timely manner. A jurisdiction request may be filed for a couple of reasons. First, a firm or individual may file a jurisdiction request to determine which list—the CCL or the USML—their particular item may fall under. A firm or individual may also file a jurisdiction request if they believe their item does not fall under export control.

Although the process involves multiple organizations, the Department of State is ultimately responsible for administering Commodity Jurisdiction Requests. Data for the number of jurisdiction requests as well as the average time to process those requests were provided from the Bureau of Political-Military Affairs, DDTC. These requests are then divided by 12 to fit the monthly timeframe of the model. Running the model, on average it appears DDTC receives about eight to 39 requests a month for space systems. Additionally, the model simulates an average processing time of just over a month.

Submitted Export License Applications submodule. The Submitted Export License Applications submodule works in the same manner as the Department of Commerce Submitted Export License Applications submodule. According to metrics provided by the Department of State website, the DDTC receives approximately 6,100–8,400 applications per month for licenses covering all ITAR categories (Department of State, 2011b). The model is adjusted to 5.2 percent factoring in the Department of State's breakout of export control licenses (Department of State, 2006; 2007; 2008; 2009; 2010). This equates roughly to about 322 to 431 space export licenses a month. Approximately 84 percent of those applications are approved, 15 percent are returned without action, and less than 1 percent are denied. The average processing time within the model for those applications hovers around 14 to 19 days. This corresponds closely to data reported by the Department of State, where processing time averages around 14 to 20 days (Department of State, 2011b).

Observations

Data produced from the model seem to dispel the AFRL survey's finding that export control licensing is preventing the industry from successfully competing in the international market. The majority of export licenses currently handled by the Department of State are processed within 14 to 19 days vice the 52 and 106 days reported by the AFRL survey. Further, not only did the Department of State dramatically reduce the amount of time to process an application, but did so while handling a 20 percent annual increase in the number of license applications submitted (Government Accountability Office, 2010). The Department of Commerce also reveals reasonable results as it handles 77–88 applications a month and approves roughly 70 of them. A summary of the model's results can be found in the Table. The remarkable improvement in processing times can be attributed to the use of electronic systems to handle

requests, increased staff, and training. The reduced processing times coupled with the increased volume of export licenses also corresponds with a steady increase in sales. In 2007, the industry saw approximately $36 billion in sales and grew continually, whereas in 2010 the industry saw $41 billion in sales (U.S. Census Bureau, 2011).

TABLE 1. SUMMARY MODEL RESULTS

Department of Commerce	Result	Department of State	Result
Commodity Classification Requests	24–30	Commodity Jurisdiction Requests	8–39
Classification Request Processing Time	33–42 days	Jurisdiction Request Processing Time	36–40 days
License Applications	77–88	License Applications	322–431
License Processing Time	26–32 days	License Processing Time	14–19 days
Licenses Approved	65–74	Licenses Approved	270–362

Additional factors coupled with more current data also seem to throw the AFRL survey results into question. For instance, an unsteady demand in the acquisition of satellites is prevalent across the entire international market, not just the United States. Specifically, in 2002 international satellite manufacturing reported $11 billion in sales, dropped to $7.8 billion in 2005, rose to $12 billion in 2006, and then dropped again to $10 billion in 2010 (Satellite Industry Association, 2011). This could help explain why the AFRL survey saw significant losses in satellite manufacturing. Another factor to consider is the implementation of protectionist strategies. Nations enacting these policies often subsidized their space industries and promoted internal purchase preferences. In fact, for those firms surveyed, protectionism was the leading write-in factor as a barrier to entry into the international market. "The number one write-in factor reflecting how U.S. firms view the current international competitive environment was 'buy European/protectionism' ... U.S. firms

are being excluded from foreign markets … for noncompetitive reasons" (Department of the Air Force, 2007). A shift also appears to be occurring in the industry that could also account for declining spacecraft sales. For example, satellite services sales accounted for 50 percent of sales in 2002, then rose steadily every year since, and in 2010 represented 60 percent of all sales (Satellite Industry Association, 2011).

The AFRL survey asserts that export control regulations are hurting the industry. During the 2006–2010 time period, export control most likely had an impact on the industry—although a myriad of other activities and events were also impacting the industry as well, not just export control. If export controls were lifted in their entirety, the United States would undoubtedly see a boon in the space industry for a period of time. Admittedly, from an economic perspective, export control regulations do inhibit the industry to a degree. However, that inhibition is in exchange for maintaining national security. Regardless, it does not prevent the industry from being successful; in fact, the industry is showing signs of succeeding. Thus, the observations and statements of the AFRL survey on the state of industry are now questionable.

Recommendations

Undoubtedly, the proposal offered by the Obama Administration will bring some added benefit. Efficiencies are naturally expected to be gained from reforms such as a single information technology system and a single enforcement agency. Albeit these reforms will take years and Congressional action to enact, and they appear more likely to benefit the departments and agencies involved in export control rather than help the industrial base compete in the international market. Aside from export control, there are some areas where the U.S. Government could help the industrial base in the domestic market. Two such measures could include implementing a more distributed space architecture and addressing the anticipated space systems acquisition workforce skill shortage.

Currently, the federal government is by far the largest consumer of products and services offered by the U.S. space industry. Unfortunately, the government insists on buying large, complicated space systems commonly referred to as Battlestar Galacticas. The problem with these systems is that they are one-of-a-kind, which doesn't allow the industry to mass-produce parts that have the potential to continually generate income. Specifically, the AFRL survey stated the inability to mass-produce spacecraft components was one reason why many firms were leaving the space market (Department of the Air Force, 2007). Thus, once they build one space system, they have to retool and re-engineer their manufacturing processes to build the next. However, the government could purchase smaller, less complicated satellites on a larger scale. The United States could employ a system of satellites that work together to perform a function or set of functions. Not only would this provide opportunities for modular engineering, plug-and-play parts, and mass production, but it would also enhance the resiliency of the nation's space architecture.

For example if one system fails, functionality is not lost because of built-in redundancy. Additionally, firms are better prepared to weather the effects of hostile operations against their systems. In short, producing greater numbers of smaller satellites that are modular in design may provide enough of a business case for those firms to remain in the market.

As for the space systems acquisition workforce, many U.S. firms do retain a reasonably stable workforce. However, many respondents on the AFRL survey stated that a skill shortage exists in the workforce. Addi-

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tionally, a significant portion of the space systems acquisition workforce is nearing retirement, and this potentially represents a significant loss of knowledge and experience. The U.S. Government and industry could offer incentives such as generous scholarships or grants to those students who enroll in engineering and program management programs with a space systems acquisition concentration. This would attract and produce new entry workers with skills the industry needs. Strong mentoring and training programs for the middle- and entry-level positions can help stave off some of the effects of massive retirement.

Summary

Space is an economic and national security advantage for the United States. It plays a role in our banking and financial industries, it provides entertainment and enables us to communicate globally, it obtains information on otherwise denied areas, and it acts as a force multiplier in the conduct of military operations. In short, our leadership in space ensures our national security and our standing as a world leader.

However, space systems acquisition is inherently complex, and our inability to acquire such systems may jeopardize our leadership in the field of space. In particular, the health of the space industrial base presents a serious challenge to our acquisition of these systems. Studies and surveys point to relatively flat profits, and some have made projections that the space industrial base will shrink by 50 percent in the next few years (DeFrank, 2006). Should this trend continue, the DoD could find itself relying upon foreign providers for the parts and components it needs to build space systems.

The industry points to export control regulations as a primary cause and often cites the AFRL survey as validation of their concern. The industry believes regulations for obtaining an export license are complex and overly cumbersome. As a result, they believe they are unable to compete effectively in the international market, and thus focus their efforts on the domestic market. However, the federal government is the largest consumer of space services and manufacturing and buys "one-of-a-kind" systems—and does so sporadically.

Using System Dynamics Modeling, this article examined the AFRL survey's claim that the export control process is preventing the U.S. space industrial base from successfully competing in the international

market. Perhaps this was the case between 2002 and 2006. However, examining the modeling data from 2007 to 2010 reveals drastically shorter processing times along with a significant increase in the amount of license applications received. Further, when examining space sales from 2007 to 2010, we see a continual increase. Market shares may have decreased, particularly in satellite manufacturing, but that could also represent a shift in industry to a slightly more lucrative market such as satellite services. Further still, a decline in market shares could also be explained by subsidized firms and protectionist strategies that tilt the field in favor of competitors.

Nonetheless, continuing to rely upon the data within the AFRL survey to claim that export licensing is preventing the U.S. space industrial base from competing successfully in the international market no longer appears warranted. Export control may inhibit industry for the sake of national security, but it certainly does not prevent it from succeeding.

Author Biographies

Mr. Barry "Jay" Borst currently works at the National Geospatial-Intelligence Agency and is assigned to the Commercial Imagery Program. His research interests include acquisition policy and innovation. Mr. Borst is currently a PhD candidate in systems engineering at The George Washington University. He holds a BA in Political Science from the State University of New York (SUNY) at Albany; and an MS in Systems Engineering from The George Washington University.

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